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DiagnoseHeadaches by Fuzzy Procedures

Yi-Fong Lin

Department of Fashion Industry Management, Hsing Wu University
New Taipei City 25103, Taiwan
109287@mail.hwu.edu.tw

Abstract: ***This paper is a response to the article of Ahn, Mun, Kim, Oh, and Han that was published in IEICE Transactions on Information and Systems, Volume E91-D, Number 4, APRIL 2008, 1215-1217. We will point out that their extension is based on the detailed data of knowing the frequency of three types such that their new occurrence information that was based on an intuitionistic fuzzy set for medical diagnosis of headache becomes redundant. We will advise researchers directly to use the detailed data to decide the diagnosis of headaches.***

Keywords: fuzzy measure, interview chart, fuzzy differential diagnosis

1. Introduction

Researchers have studied the article of Ahn, Kim, and Kim that was published in IEICE Transactions on Information and Systems, volume E86-D, number 12, 2003, pages 2790-2793. In this paper, we will further examine another paper from this research group of Ahn,Mun, Kim, Oh, and Han that was published in IEICE Transactions on Information and Systems, volume E91-D, number 4,2008, pages 1215-1217. Before we focus on Ahn et al. [3], we provide a brief review of related research trends. Sanchez [9] studied fuzzy relation equations by resolution of composite. Smets [11] applied fuzzy sets and degrees of belief to medical diagnosis. Atanassov [4] extended fuzzy sets to intuitionistic fuzzy sets. Adlassnig [1] extended the fuzzy set theory to medical diagnosis. Based on the fuzzy number and compositional rule of inference, Yao and Yao [13] considered fuzzy decision-making to apply it to medical diagnosis. Kumar et al. [8] examined intuitionistic fuzzy sets for medical diagnosis with applications. Ahn et al. [2] applied fuzzy classification and linear regression methods to diagnose headaches. Yamada [12] studied compound effects under the causal possibility method. With natural languages,Sanchez [10] adopted truth-qualification and fuzzy relations to deal with medical diagnosis.With intuitionistic fuzzy sets,Dubois et al. [5] developed fuzzy set theorems to solve terminological difficulties. Kim et al. [6] diagnosed headacheswith fuzzy procedures. Ahn et al. [3] studied fuzzy methods to identify headaches. Klir and Folger [7] developedfuzzy sets structure under information uncertainty.

Fuzzy Set Theorem had been applied to many practical situations in real life. For example, Sanchez [9] used the doctor's medical information as a fuzzy relation between symptoms and disease. Atanassov [4] extend the fuzzy set to an intuitionistic fuzzy set (IFS) such that for a fixed set E, an IFS A is assumed as

$$A=\{\langle x,\mu_A(x),\nu_A(x)\rangle | x\in E\}, \tag{1}$$

where $\mu_A(x): E\to[0,1]$ is the degree of membership, and $\nu_A(x): E\to[0,1]$ is the degree of non-membership that satisfies

$$0\le \mu_A(x)+\nu_A(x)\le 1. \tag{2}$$

Moreover, the hesitation is assumed as

$$\pi_A(x)=1-\mu_A(x)-\nu_A(x). \tag{3}$$

2. Review the approach of Ahn et al. [3]

To concentrate on the discussion of the new derivation of Ahn et al. [3], we overlook the composition of fuzzy relations, and then directly consider the intuitionistic fuzzy relation between a patient and diseases (migraine headache, d_M; tension headache, d_T, and cluster headache, d_C) as

$$\langle \mu(P,d_M),\nu(P,d_M)\rangle=\langle 0.6,0.3\rangle, \tag{4}$$

$$\langle \mu(P,d_T),\nu(P,d_T)\rangle=\langle 0.5,0.3\rangle, \tag{5}$$

and

$$\langle \mu(P,d_C),\nu(P,d_C)\rangle=\langle 0.4,0.3\rangle. \tag{6}$$

Based on Klir and Folger [7], Ahn et al. [2] will determine the diagnostic labels of this patient for those diseases, say d_i, that satisfies

$$0.5<\mu(P,d_i), \tag{7}$$

and

$$\nu(P,d_i)<0.5. \tag{8}$$

Hence, Ahn et al. [2] will diagnose the patient suffering from migraine headache with 60% degree of membership and tension headache with 50% degree.

Ahn et al. [3] considered that $\mu(P,d_i)$ and $\nu(P,d_i)$ did not include information about the occurrence frequency of symptoms for the patient's disease. If the occurrence frequency is f_i corresponding to a disease d_i, then Ahn et al. [3] suggested that the revised measure should be assumed as

$$\mu'(P,d_i)=\mu(P,d_i)+f_i*\pi(P,d_i), \tag{9}$$

and

$$\nu'(P,d_i)=\nu(P,d_i)-f_i*\pi(P,d_i). \tag{10}$$

For example, if a patient has three types of headache: migraine headache, tension headache, and cluster headache, and symptoms for each type occur 4, 2, and 14 times respectively, then the occurrence frequencies are assumed as $f_M = 0.2$, $f_T = 0.1$ and $f_C = 0.7$, respectively.

Consequently, Ahn et al. [3] derived that

$$\langle \mu'(P, d_M), \nu'(P, d_M) \rangle = \langle 0.62, 0.28 \rangle, \quad (11)$$

$$\langle \mu'(P, d_T), \nu'(P, d_T) \rangle = \langle 0.52, 0.28 \rangle, \quad (12)$$

and

$$\langle \mu'(P, d_C), \nu'(P, d_C) \rangle = \langle 0.61, 0.09 \rangle, \quad (13)$$

so they concluded to diagnose the patient suffered from migraine headache with 62% degrees of membership, tension headache with 52% degrees, and cluster headache with 61% degrees.

3. Questionable results in their derivation

We will point out that if the symptoms of a patient for three types: migraine headache, tension headache, and cluster headache, occur 4, 2, and 14 times respectively, then this information will directly imply the patient suffered cluster headache.

Ahn et al. [3] tried to use the occurrence frequency to derive a new set of IFS that is redundant. They over-studied the pattern recognition problem.

Moreover, their interview chart also contained an interesting record. For migraine headaches, it happens 4 times, and then there are M5, M8, M18, and M19 in the interview chart. For a tension headache, it happens 2 times, and then there are T3, T5, T10, and T14 in the interview chart. For cluster headaches, it happens 14 times, and then there are C4, C11, and C13 in the interview chart.

It reveals that the patient has cluster headaches 14 times with concentration symptoms: C4, C11, and C13. This information will help a doctor to decide what kind of cluster headache and then find a solution or a relief treatment for this patient.

4. Conclusion

Ahn et al. [3] overlooked useful information and then they only tried to derive a new set of IFS. We may advise researchers not to apply their approach to avoid questionable diagnoses to endanger patients' health.

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Author Profile

Daniel Yi-Fong Lin received a Ph.D. degree from the Department of International Business Administration at Chinese Culture University from 2010 to 2015. Now is an assistant professor teaching in the Department of Fashion Industry Management, at Hsing Wu University.